$Ba_3BiPbREO(BO_3)_4$ (*RE* =Pr, Nd, Gd, Dy): Two-Dimensional Rare-Earth Antiferromagnets with Geometrically-Perfect Triangular Lattice Directed by Triangular BO_3 Unit

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Table S1 Lattice parameters and Rietveld refinement results for $Ba_3BiPbREO(BO_3)_4$ ((RE = Pr, Nd, Gd, Dy) with space group $P6_3/mmc$ ($\alpha = \beta = 90°$, $\gamma = 120°$).

RE		**Pr**	**Nd**	**Gd**	**Dy**
***a* (Å)**		5.3971(1)	5.4040(1)	5.4289(1)	5.4188(1)
***c* (Å)**		26.9444(3)	26.8712(3)	26.3741(3)	26.2776(3)
***V* (Å^3)**		679.71(1)	679.60(1)	673.17(1)	668.22(1)
	x	0	0	0	0
RE	***y***	0	0	0	0
	z	1/2	1/2	1/2	1/2
	x	0	0	0	0
Bi	***y***	1	1	1	1
	z	0.3301(1)	0.6686(1)	0.6667(1)	0.6663(1)
	x	0	0	0	0
Pb	***y***	1	1	1	1
	z	0.3301(1)	0.6686(1)	0.6667(1)	0.6663(1)
	x	2/3	2/3	2/3	2/3
Ba1	***y***	1/3	1/3	1/3	1/3
	z	0.4090(1)	0.5900(1)	0.5880(1)	0.5869(1)
	x	2/3	2/3	2/3	2/3
Ba2	***y***	1/3	1/3	1/3	1/3
	z	1/4	3/4	3/4	3/4
	x	1/3	1/3	1/3	1/3
B1	***y***	2/3	2/3	2/3	2/3
	z	0.447(2)	0.5495(16)	0.5505(12)	0.5511(8)
	x	1/3	1/3	1/3	1/3
B2	***y***	2/3	2/3	2/3	2/3
	z	0.3195(15)	0.6803(14)	0.6758(17)	0.6743(1)
	x	0	0	0	0
O1	***y***	1	1	1	1
	z	1/4	3/4	3/4	3/4

	x	0.4702(9)	0.4772(9)	0.4791(9)	0.4773(7)
O2	***y***	0.5298(9)	0.5228(9)	0.5209(9)	0.5227(7)
	z	0.3326(6)	0.6646(6)	0.6702(6)	0.6712(6)
	x	0.598(2)	0.198(2)	0.194(2)	0.194(2)
O3	***y***	0.869(5)	0.396(2)	0.388(2)	0.389(2)
	z	0.4494(5)	0.5492(5)	0.5529(4)	0.5512(3)
χ^2		8.60	9.54	4.65	8.45
R_{wp}		0.117	0.127	0.129	0.106

Table S2 Selected distances for $Ba_3BiPb\textit{RE}O(BO_3)_4$ (*RE* = Pr, Nd, Gd, Dy).

Distances	Length/Å			
	Pr	Nd	Gd	Dy
RE−O	2.303(19)	2.277(11)	2.265(12)	2.267(8)
$RE-RE_{intra}$	5.394(2)	5.404(1)	5.439(1)	5.419(1)
$RE-RE_{inter}$	13.470(4)	13.436(1)	13.192(1)	13.139(1)
B−O	1.355(19)	1.267(9)	1.371(12)	1.304(8)
	1.360(20)	1.411(13)	1.386(15)	1.354(5)

Figure S1 Examples of crystals for (a) $Ba_3BiPbPrO(BO_3)_4$ and (b)$Ba_3BiPbGdO(BO_3)_4$.

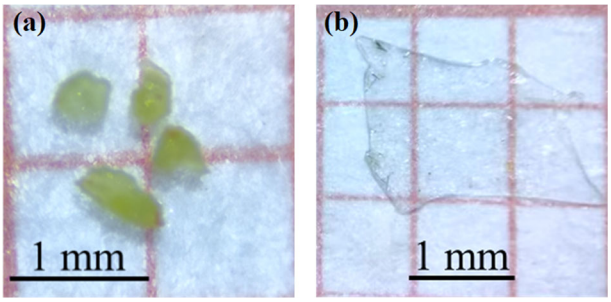

Figure S2 EDS-mapping for (a) $Ba_3BiPbPrO(BO_3)_4$, (b) $Ba_3BiPbNdO(BO_3)_4$, (c) $Ba_3BiPbGdO(BO_3)_4$ and (d) $Ba_3BiPbDyO(BO_3)_4$.

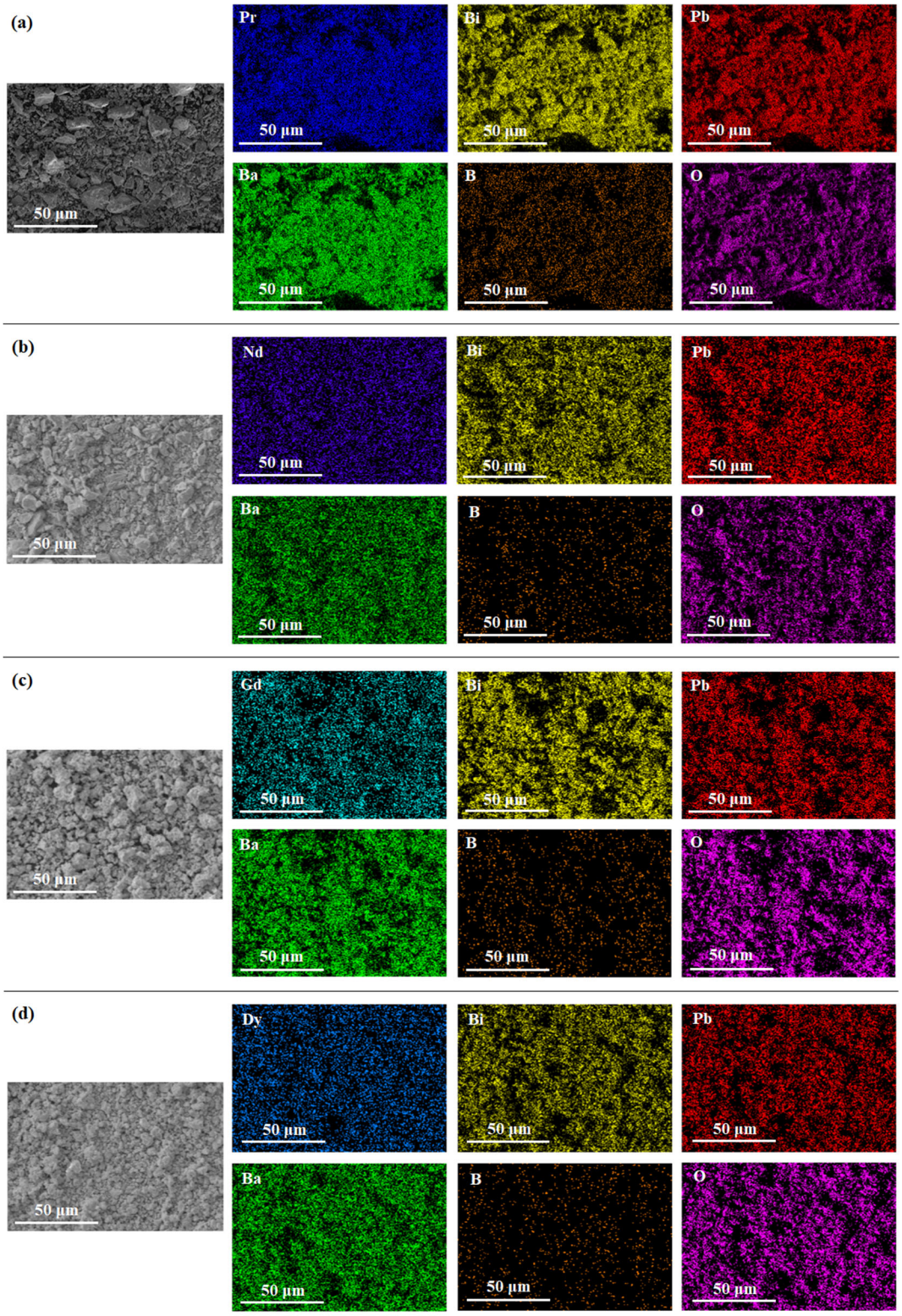

Figure S3 ATR-FTIR spectra for $Ba_3BiPbREO(BO_3)_4$ (RE = Pr, Nd, Gd, and Dy) in the range of 400-4000 cm^{-1}.

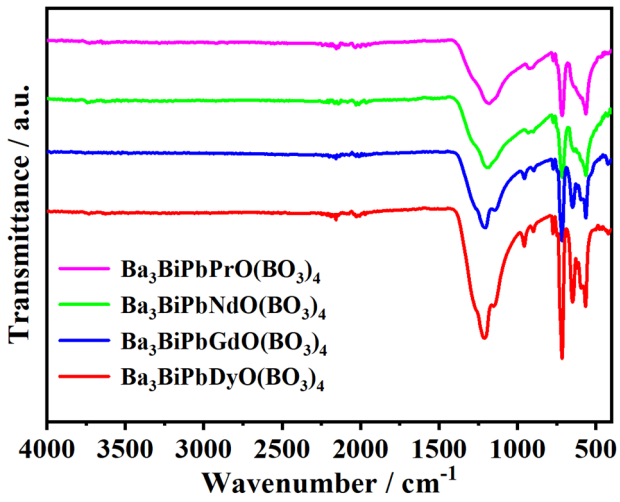

Figure S4 The indirect band gap for (a) $Ba_3BiPbPrO(BO_3)_4$, (b) $Ba_3BiPbNdO(BO_3)_4$, (c) $Ba_3BiPbGdO(BO_3)_4$ and (d) $Ba_3BiPbDyO(BO_3)_4$.

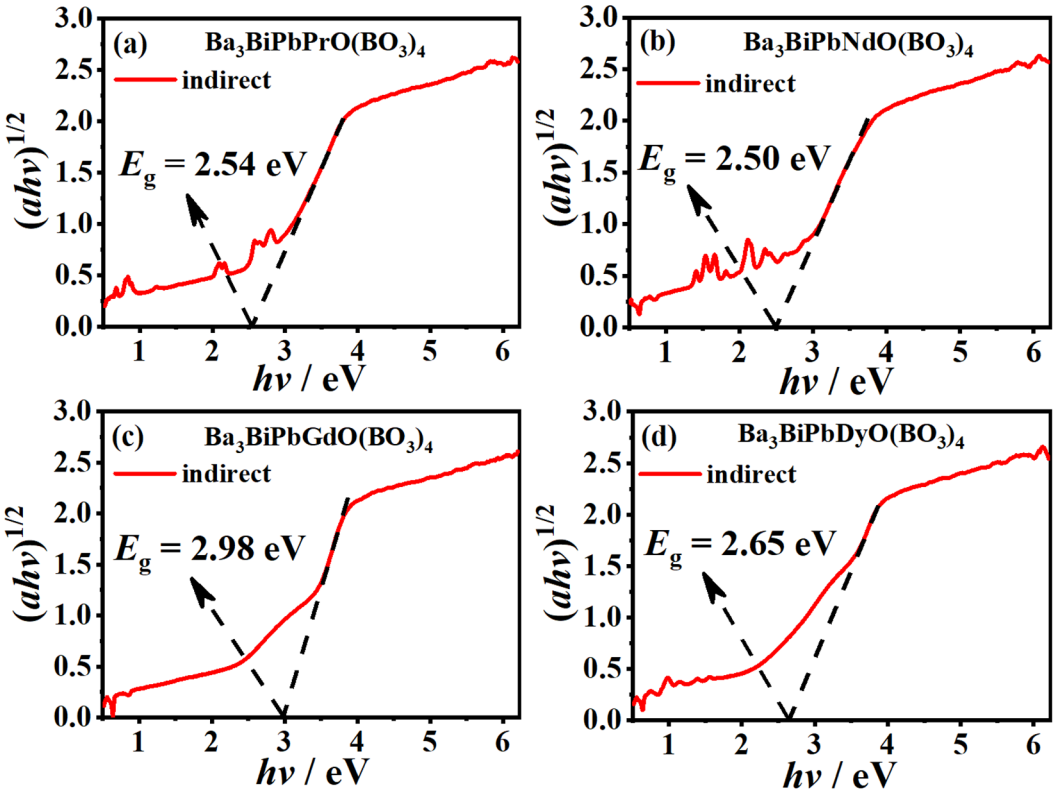

Figure S5 The enlarged plot of the specific heat for $Ba_3BiPbREO(BO_3)_4$ (RE = Pr, Nd, Gd, Dy) in the range of 0-10K.